Update on 802.11ax

Laboratory Division
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FCC

802.11ax

- Key Features:

1. Operates in the 2.4GHz & 5 GHz bands
2. Backwards compatible with 802.11a/b/g/n/ac
3. Increased avg. throughput (up to 4X) per user in dense environments
4. Allows for single User (SU) or Multi User (MU) operation through OFDMA (legacy 802.11ac MU-MIMO is also supported)
5. Longer OFDM symbols
6. Supports MCS-10 & MCS-11(1024-QAM)
7. Improved power saving techniques

Resource Units (RU)

- 802.11ax adds SU or MU operations using OFDMA. Legacy MU-MIMO also supported (using OFDM).
- OFDMA employs multiple subcarriers. The subcarriers are divided into several groups where each group is denoted as a Resource Unit.
- Following RUs are defined for DL & UL transmission:
  - 26-tone RU
  - 52-tone RU
  - 106-tone RU
  - 242-tone RU
  - 484-tone RU
  - 996-tone RU
  - 2x996-tone RU

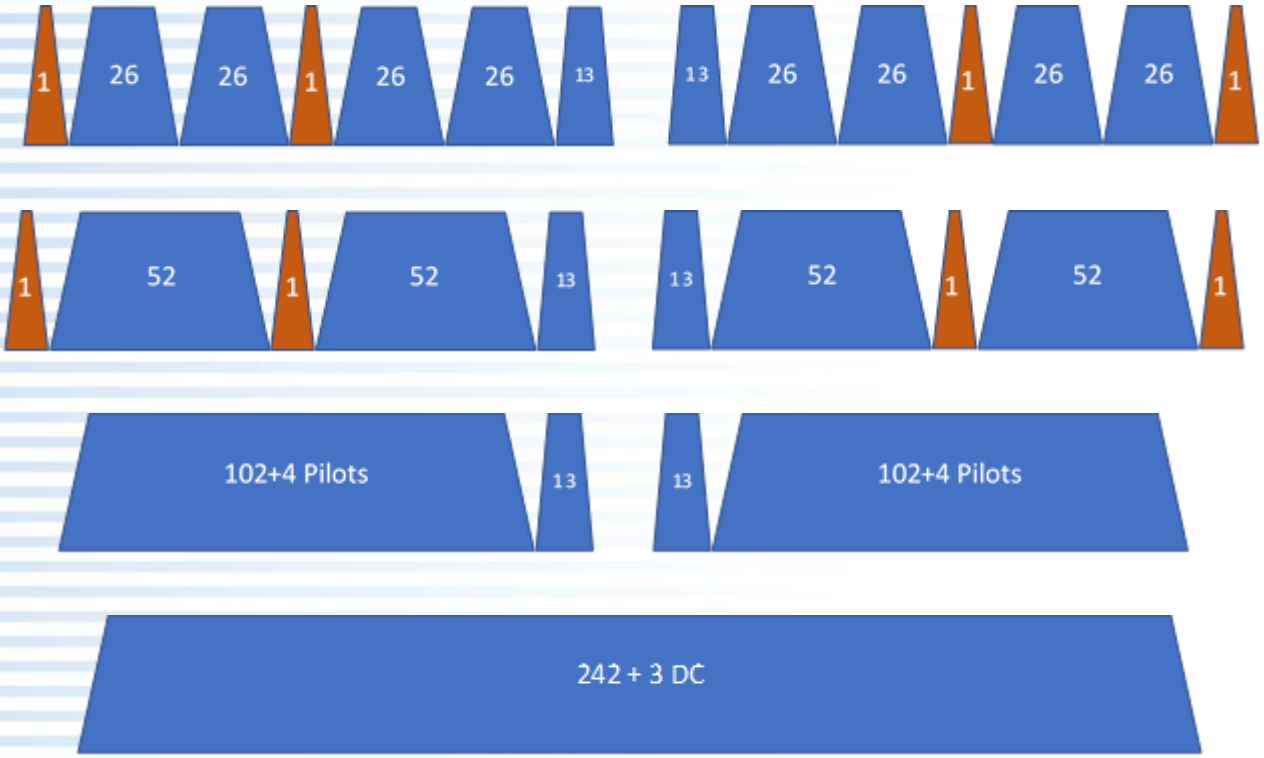
A OFDMA transmission can carry a mixture of 26, 52, 106, 242, 484 and 996-tone RUs.

RU Allocation

- DL MU Operation (Access Point)
  - There are many restrictions stated in the draft standard. Among them, there is the following requirement on the minimum number of RUs:
    - At least N x 4 x 26 subcarriers are modulated by the allocated RUs within the entire payload
      - N: number of 20 MHz subchannels that are not preamble punctured
- UL (or DL) Operation
  - Maximum number of RUs are stated for each channel bandwidth
  - For example, for 20 MHz channel bandwidth, there are
    - Nine 26- tone RUs, four 52- tone RUs, two 106-tone RUs and one 242-tone RUs

RU Allocation - 20 MHz Fully loaded

- The following are different RU configurations (but not all) for a 20 MHz channel.



CITIZENS BROADBAND RADIO SERVICE DEVICES (CBSDs) Part 96

April 2019

CBSD – CBSD Initialization Fixed wireless CBRS service

- In point-to-point and point-to-multipoint use cases a CBSD at customer locations are unable to register with the SAS using a direct connection or out of band emissions.
  - Due to distance or other factors where no direct connection to SAS is available.
  - Because authorization from SAS of these CBSDs cannot be achieved via direct connection or out of band emissions, a "handshake procedure" has been created to allow for initial transmissions in-band.

CBSD – CBSD Initialization Fixed wireless CBRS service

- Customer location devices in handshake procedure are called CPE-CBSDs.
- Base stations connecting to CPE-CBSDs are called BTS-CBSDs.
- Initial transmission between BTS-CBSD and CPE-CBSD will be allowed in-band when following the proper procedures.
  - lowest power level necessary for communications with the BTS-CBSD.

Draft CPE-CBSD Handshake KDB

- Still in draft format.
- Intent to allow authorization of CPE-CBSDs
  - Outline way forward for CPE-CBSDs to connect with BTS-CBSD initially to register and receive authorization from SAS.
- New equipment class for CPE-CBSDs.
  - CBC

Draft CPE-CBSD Handshake KDB

- CPE-CBSDs can not yet be authorized as CBSDs.
  - WInnForum is in the process of developing test specification and procedures which must be included in the CPE-CBSD filing.
- If not using WInnForum developed test procedures applicant must submit KDB inquiry prior to PAG for approval of protocol and test procedure used.

CBD Applications

- Applications for CBSDs (Equipment Class CBD) must clearly define how initially communication with SAS is achieved
  - Over what medium?
- Provide list of applicable antennas within the test report.
- List power on grant as total EIRP over entire bandwidth (i.e. for 40 MHz BW total EIRP over 40 MHz).
  - Power listed on grant over entire BW must be reflected in test report.
  - Grant note EP.

Consumer and Industrial Boosters KDB Pub. 935210 Changes

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KDB Pub. 935210 Status

- Survey upcoming key change topics from 2018 NPRM (pending FCC rulemaking action)
- KDB Pub. 935210 changes highlights
  - D03 and D04 multiple-server-port booster test procedure
  - D02 frequency bands for Part 20 industrial boosters
  - Misc. changes D02, D03, D04, D05

KDB Publication 935210 preceding versions:

- D02 v04r01 (June 2018) basic policies and procedures
- D03 v04r02 (June 2018) wideband consumer boosters
- D04 v02r02 (June 2018) provider-specific consumer boosters
- D05 v01r02 (Oct. 2017) industrial boosters

PENDING Rule Changes FCC 18-35

- Key change topics from 2018 Second Further NPRM (FCC 18-35, Docket No. 10-4) = pending FCC rulemaking action
  - Enterprise use for wideband consumer boosters
  - Changes to basic and vehicle-embedded consumer booster label/advisory requirements
  - Other spectrum bands for consumer boosters
- Reminder–NO CHANGES AT PRESENT for:
  - Frequency bands allowed for Consumer Boosters [Secs. 20.21 (a)(4) & (e)(3) unchanged so far]
  - Labeling and advisories for Consumer Boosters

935210 D03 & D04 Updates

- Test procedure for single-donor-port multiple-server-port consumer signal boosters (CSB)
  - Prepared by ASC C63® SC4 working group (Oct. 2018), for inclusion in C63.26 revision draft
  - Added as new 7.15 in 935210 D03 and new 7.17 in 935210 D04
  - Example booster use case is coverage across multiple building regions using multiple antennas
- Summing of test data across (*N*>1) DL ports
  - Required if installation allowed with multiple server-port antennas providing coverage to same area within building
  - Not required if installation allowed with multiple server-port antennas providing coverage ONLY to different areas within building (e.g. minimum 10 m separation)

Freq. Bands for Industrial Boosters (1)

- Table D.2 of 935210 D02 lists CMRS bands (as of mid-2018) for routine equipment-class B2I e-filings
- Bands recently considered as subject to Sec. 20.21 industrial booster rules include Part 30 and Part 96 – see next page
  - Sec. 20.21(f) labeling/advisory applies; use B2I
- One example band/service not allowed for booster equipment grants is DSRC
  - ASTM-E2213 compliance required for OBU transmitters
  - 5850-5925 MHz use changes under consideration (e.g., open rulemakings docket nos. 13-49 and 18-357)
  - Licensed-by-rule and Public-Safety aspects might need special consideration

Freq. Bands for Industrial Boosters (2)

- Sec. 20.21 industrial booster rules apply for Part 30 and Part 96 boosters (including DAS)
  - Part 30 Subpart C
    - Testing generally follows KDB Pubs. 842590, 935210 D05, and 935210 D02
  - Part 96
    - Testing generally follows KDB Pubs. 940660, 935210 D05, and 935210 D02
    - EIRP > 23 dBm / 10 MHz: CBSD requirements apply including register with and follow SAS directions
    - EIRP < 23 dBm / 10 MHz: EUD requirements apply for operation with a CBSD
- Part 30 and Part 96 equipment at present subject to PAG (47 CFR Sec. 2.964; KDB Pub. 388624 D02)
  - 388624 D02 v16r04 II) C) 2) l) ('ell') Part 30 UMFUS
  - 388624 D02 v16r04 II) B) 2) Part 96 CBRS

935210 Other Misc. Changes

- 935210 D02 changes
  - Reference to KDB Pub. 784748 multi-enclosure labeling considerations added for booster systems
  - Existing guidance on external filters added (from inquiry responses and FCC-TCB telecon. notes)
  - Misc. editorial cleanups
- 935210 D05 cross-references corrections at several places
  - Aligned with ANSI C63.26-2015

WRAP

Test labs, applicants, and TCBs please let us know in case of other KDB Publication change requests

Update and Status of Select ANSI C63 Standards

TCB Workshop
April 17, 2019

C63.4: Methods of Measurement of Radio Noise Emission in range of 9 kHz to 40 MHz

- Update to C63.4-2014 standard continues with publication by ANSI anticipated in CY 2019.
- C63.4a Amendment published by ANSI in CY 2017.
  - FCC Public Notice (PN) DA 19-152 released on April 2nd, 2019 seeking public comment on proposal to incorporate into FCC Part 15 rules.
  - Same PN also seeking comment on intention to include 2017 revision of ISO/IEC 17025 standard, pertinent to the accreditation of Certification Bodies and Testing Laboratories, into Part 15 rules.
  - 30-day comment period beginning after publication of PN in Federal Register
  - Visit https://docs.fcc.gov/public/attachments/DA-19-152A1.pdf for more information.

- DA 19-152 released April 2, 2019
- Comments due 30 days after publication in Federal Register

C63.10: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

- Revision to C63.10-2013 recently submitted from the Working group to the Subcommittee (SC4) for consideration of proposal to provide to Main Committee for review.
- Goal is to publish this revision in CY 2019.
- Includes updates to ensure consistency with revisions implemented in other ANSI Standards (*e.g.*, C63.4) and in FCC KDB guidance (*e.g.*, U-NII), as well as new material respondent to unlicensed technologies introduced since initial publication (*e.g.*, whitespace devices)

C63.26: American National Standard of Procedures for Compliance Testing of Transmitters Used in the Licensed Radio Services

- Revisions to ANSI C63.26-2015 standard continue.
- Updates to Radiated Emissions and Signal Booster clauses completed.
- Development of compliance test procedures for mmWave devices under Part 30 requirements close to completion:
  - Material developed by Task Group used to develop recently published KDB guidance (KDB Pub 842590).
- Procedures for compliance testing of radar devices to Part 95M requirements also nearing completion by Task Group.
- Publication of revised C63.26 standard anticipated in CY 2020.

Questions?